Claims

1. An analyte-manipulation device for moving a polarizable analyte of interest with respect to a sample holder configured to hold such analyte, comprising:

at least two coextensive, elongated, electrically-conductive members disposed in fixed, spaced relation; with said members and said holder being adapted for relative movement between a first position wherein at least a portion of said members is disposed within said holder and a second position wherein said members are disposed outside of said holder;

an AC power source adapted for electrical communication with said electrically-conductive members;

wherein, with said members and holder disposed at said first position, said AC power source is operable in combination with said electrically-conductive members to establish an electrical field gradient within said holder, adjacent said members.

2. The device of claim 1, further comprising a control unit for controlling the position of the electrically-conductive members with respect to said sample holder.

3. The device of claim 1, further comprising a holder-handling apparatus for moving said sample holder toward and away from said electrically-conductive members.

4. An analyte-manipulation device, comprising:

a movable support;

at least two coextensive, elongated, electrically-conductive members;

said electrically-conductive members being held by said support for movement therewith;

said electrically-conductive members having spaced-apart end regions, with an intervening region between said end regions defining a concentration zone;

an AC power source adapted for electrical communication with said electrically-conductive members;

wherein, upon positioning said support so that said end regions are disposed in an electrolyte solution containing a polarizable analyte of interest, said AC power source is operable in combination with said electrically-conductive members to establish an electrical field gradient between said end regions effective to trap at least a portion of said polarizable analyte in the concentration zone.

5. The device of claim 4, further comprising a resin material, wherein at least a portion of each of said end regions of said electrically-conductive members is contained within said resin material.

6. The device of claim 5, wherein said resin material comprises an epoxy bead.

7. The device of claim 4, further comprising a porous material encapsulating said end regions.

8. The device of claim 4, wherein at least a portion of at least one of said electrically conductive members includes one or more surface features selected from the group consisting of edges, corners, angles, bumps, protrusions, teeth, undulations, notches, indentations, waves, ripples, fins, and any combination thereof.

9. The device of claim 8, wherein said members include surface features along confronting portions of their end regions comprising edges or points.

10. The device of claim 4, further comprising a non-conductive filament extending along at least one of said members.

11. The device of claim 4, wherein said support is configured as a handle permitting an operator to hold and position the device by hand.

12. The device of claim 4, wherein two or more pairs of said coextensive, elongated, electrically-conductive members are held by said support.

13. The device of claim 4, further comprising a DC power source adapted for electrical communication with said electrically-conductive members.

14. An analyte-manipulation device, comprising:
an elongated, electrically-conductive member having an end region;
a marginal region alongside said end region defining a concentration zone;

a vessel having side and bottom walls, with at least a portion of at least one of said walls comprising an electrically conductive material;

said end region of said electrically-conductive member being movable from a position outside of said vessel to a position within said vessel in spaced-apart relation with respect to said wall portion; and

an AC power source disposed for electrical communication with said electrically-conductive member and said wall portion;

wherein, upon positioning said member so that said end region is positioned in said vessel so as to be submerged in an electrolyte solution containing a polarizable analyte of interest held therein, said power source is operable to establish an electrical field gradient adjacent said end region effective to trap at least a portion of said polarizable analyte in said concentration zone.

15. An analyte-manipulation device, comprising:

an elongated, electrically-conductive member having an end region;

a marginal region alongside said end region defining a concentration zone;

a vessel having side and bottom walls, with at least a portion of at least one of said walls comprising an electrically conductive material electrically coupled to ground;

said end region of said electrically-conductive member being movable from a position outside of said vessel to a position within said vessel in spaced-apart relation with respect to said wall portion; and

an AC power source disposed for electrical communication with said electrically-conductive member;

wherein, upon positioning said member so that said end region is positioned in said vessel so as to be submerged in an electrolyte solution containing a polarizable analyte of interest held therein, said power source is operable to establish an electrical field gradient adjacent said end region effective to trap at least a portion of said polarizable analyte in said concentration zone.

16. An analyte-manipulation device for moving a charged analyte of interest with respect to a sample holder configured to hold such analyte, comprising:

at least two coextensive, elongated, electrically-conductive members disposed in spaced apart relation; with said members and said holder being adapted for relative movement between a first position wherein at least a portion of said members is disposed

within said holder and a second position wherein said members are disposed outside of said holder; wherein at least one of said members is a bubble-free electrode;

a DC power source adapted for electrical communication with said electrically-conductive members; wherein, with said members and holder disposed at said first position, said DC power source is operable in combination with said electrically-conductive members to establish an electrical potential within said holder, between said members.

17. An analyte-manipulation device, comprising:

a movable support;

at least two electrodes held by said support and having end regions disposed in spaced-apart relation with respect to one another, with at least one of the electrodes being a bubble-free electrode;

a DC power source adapted for electrical communication with said electrodes;

wherein, upon positioning said electrodes in an electrolyte solution containing a biomolecule of interest bearing an electrical charge, said DC power source is operable to provide one of the electrodes with a positive electrical charge and the other of the electrodes with a negative electrical charge, such that the charged biomolecule is caused to migrate toward the end region of the electrode of opposite electrical charge.

18. A biomolecule-manipulation device, comprising:

(i) first and second electrodes, wherein at least one of said electrodes includes (a) a capillary tube including a first end defining a first opening, a second end defining a second opening, and an interior lumen extending between said openings, (b) an electrolyte held within said lumen, (c) an electrically-conductive element contacting said electrolyte and extending out of said lumen, and (d) a selectively permeable occlusion at a region of said capillary tube proximate said second end; and

(ii) a DC power source adapted for electrical communication with said first and second electrodes;

wherein, upon positioning said electrodes in an electrolyte solution containing a biomolecule of interest bearing an electrical charge, said DC power source is operable to provide one of the electrodes with a positive electrical charge and the other of the electrodes with a negative electrical charge, such that the charged biomolecule is caused to migrate toward the electrode of opposite electrical charge.

19. The device of claim 18, wherein said selectively permeable occlusion comprises an ion-exchange membrane covering said second opening.

20. The device of claim 19, wherein said ion-exchange membrane comprises a perflourinated ion exchange polymer.

21. The device of claim 18, wherein at least one of said electrodes is adapted for movement between a biomolecule pick-up position and a biomolecule deposition position.

22. A biomolecule-manipulation device, comprising:

(i) first and second electrodes, wherein at least one of said electrodes includes (a) a capillary tube including an inlet end, an outlet end, and an interior lumen extending between said ends, and (b) a gelled or viscous electrolyte disposed within said lumen; and

(ii) a DC power source adapted for electrical communication with said first and second electrodes, including with said gelled or viscous electrolyte;

wherein, upon positioning said electrodes in an electrolyte solution containing a biomolecule of interest bearing an electrical charge, said DC power source is operable to provide one of the electrodes with a positive electrical charge and the other of the electrodes with a negative electrical charge, thereby causing the charged biomolecule to migrate toward the outlet end of the electrode of opposite electrical charge.

23. The device of claim 22, further comprising:

a reservoir configured to hold a supply of said gelled or viscous electrolyte, with said reservoir being disposed for fluid communication with said inlet end of said capillary; and

a pressure source adapted to force at least a portion of said supply into said inlet end.

24. A biomolecule-manipulation device, comprising:

(i) first and second electrodes, wherein at least one of said electrodes includes (a) a capillary tube including an inlet end, an outlet end, and an interior lumen extending between said ends, and (b) a sieving matrix disposed within said lumen; and

(ii) a DC power source adapted for electrical communication with said first and second electrodes, including with said sieving matrix;

wherein, upon positioning said electrodes in an electrolyte solution containing a biomolecule of interest bearing an electrical charge, said DC power source is operable to provide one of the electrodes with a positive electrical charge and the other of the electrodes with a negative electrical charge, thereby causing the charged biomolecule to migrate toward the outlet end of the electrode of opposite electrical charge.

25. The device of claim 24, further comprising:

a reservoir configured to hold a supply of said sieving matrix, with said reservoir being disposed for fluid communication with said inlet end of said capillary; and

a pressure source adapted to force at least a portion of said supply into said inlet end.